CLAIMS

1. A constant-frequency machine with a varying/variable speed comprising at least one first and one second electric rotating machine with a common shaft and a converter mounted on the shaft and rotating with the shaft, **characterized** in that

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the first electric machine (1), the main machine, comprises a stator and a rotor and that both the stator and the rotor are arranged with ac windings (3, 7, 20, 21, 45, 46),

that the second electric rotating machine (27), the regulating machine, comprises a stator and a rotor and that the rotor is arranged with an ac winding (29, 48),

that the converter (28, 51), comprising a number of branches with valves, is connected between the rotor windings of the main machine and the regulating machine and that, during operation, it is arranged as an ac-to-ac converter (51a) and that, during starting, it is arranged as an ac polyphase coupler (51b) or as an ac phase-angle/voltage regulator (51c) or as an ac short-circuit coupler (51d) and that, during controlled braking and stopping, it is arranged as an ac polyphase coupler (51b) or as an ac phase-angle/voltage regulator (51c), or as an ac short-circuit coupler (51d), and

that the stator winding (7, 20, 45) of the main machine is connected to an ac power network.

2. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that, when the machine operates as an electric generator, a constant frequency of the voltage of the main machine supplied to the power network is maintained at varying speed by the

ac-to-ac converter (51a) supplying the rotor winding (3, 21, 46) of the main machine with a voltage with a frequency corresponding to the difference frequency f_c between the synchronous frequency f_r of the electric generator at the actual speed n_r and the nominal frequency f_s of the power network.

3. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that, when the machine operates as a motor, the desired speed of the machine is obtained by the ac-to-ac converter (51a) supplying the rotor winding (3, 21, 46) of the main machine with a voltage with a frequency corresponding to the difference frequency f_c between the frequency f_s of the power supply network and the synchronous frequency f_r of the machine at the desired speed n_r.

4. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the transformation ratio between the stator winding and the rotor winding is adapted to the ratio between the voltage of the power network and the maximum allowed voltage of the converter with one valve in each of the branches of the ac-to-ac converter.

5. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the stator winding (7, 20, 45) of the main machine is made from at least one cable.

6. A constant-frequency machine with a varying/variable speed according to claims 1 and 5, **characterized** in that, when the stator winding (7, 20, 45) of the main machine is made from at least one cable, the cable/cables is/are of a high-voltage type.

7. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the stator winding (7, 20, 45) of the main machine is directly connected to the ac power network.

8. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the stator winding (7, 20, 45) of the main machine is directly connected to the ac power network via a transformer (8).

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9. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the stator winding (7, 20, 45) of the main machine is designed as a 3-phase winding, a 2-phase winding, a 2x3-phase winding, or of an optional number of phase windings.

10. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the stator of the main machine, besides the stator winding (7, 20, 45) which is connected to the ac voltage network, is arranged with an auxiliary winding (41) for generating ac voltage auxiliary power.

11. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the rotor winding (3, 21, 46) of the main machine is designed as a 3-phase winding, a 2-phase winding, a 2x3-phase winding, or of an optional number of phase windings.

12. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the rotor winding (3, 21, 46) of the regulating machine is designed as a 3-phase winding, a 2-phase winding, a 2x3-phase winding, or of an optional number of phase windings.

13. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the

stator of the regulating machine is designed with a dc winding (30, 49).

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14. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the stator winding (30, 49) of the regulating machine is designed as an ac winding for a 3-phase winding, a 2-phase winding, a 2x3-phase winding, or of an optional number of phase windings.

15. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is adapted to operate with varying both input and output frequencies.

16. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is adapted to operate with a varying ratio between its input and output frequencies.

17. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is self-commutated.

18. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is machine-commutated.

19. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is commutated by the regulating machine.

20. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is designed as a matrix converter (47).

21. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is designed as a direct converter with antiparallel-connected thyristor bridges (50).

22. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that series capacitors are connected between the ac-to-ac converter (28, 47, 50, 51) and the rotor windings (29, 48) of the regulating machine.

23. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that shunt capacitors are connected between the ac-to-ac converter (28, 47, 50, 51) and the rotor windings (29, 48) of the regulating machine.

24. A constant-frequency machine with a varying/variable speed according to claims 1, 21 and 22, **characterized** in that the capacitors are connected in series and/or in parallel with the rotor windings (29, 48) of the regulating machine.

25. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the ac-to-ac converter (28, 51) is designed with an intermediate dc/dc voltage link.

26. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that the regulating machine, under controlled starting/braking/stopping is arranged as a starting/braking motor, the stator winding (49) of which is connected to an external frequency converter (53) and the rotor winding (48) of which is short-circuited by the converter of the constant-frequency machine connected as an ac short-circuit coupler (51d).

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27. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that during starting/stopping, the stator winding of the main machine is connected to the power network, the rotor winding of the main machine is connected to the rotor winding of the regulating machine via the converter arranged as an ac polyphase coupler (51b), and the stator winding (49) of the regulating machine is connected to external controllable resistors.

28. A constant-frequency machine with a varying/variable speed according to claim 1, **characterized** in that during controlled starting/braking/stopping, the stator winding of the main machine is connected to the power network, the rotor winding of the main machine is connected to the rotor winding of the regulating machine via the converter arranged as an ac phase-angle/voltage regulator (51c), and the stator winding (49) of the regulating machine is connected to external fixed resistors.

29. A method for using a converter (28, 51), rotating with the shaft, arranged between the rotor windings (3, 29) of a main machine (1) and a regulating machine (27) of a constant-frequency machine, the main machine of which is provided with a stator winding connected to a power network according to claim 1, which method is **characterized** in that

during operation, the converter is controlled as an ac-to-ac converter (51d), and

during starting, the converter is connected as an ac polyphase coupler (51b) or as an ac phase-angle/voltage regulator (51c), or as an ac short-circuit coupler (51d), and

during controlled braking and stopping, the converter is connected as an ac polyphase coupler (51b) or as an ac phase-angle/voltage regulator (51c), or as an ac short-circuit coupler.

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30. A method for using the converter, rotating with the shaft, according to claim 29 when the constant-frequency machine during operation is used as an electric generator, **characterized** in that the ac-to-ac converter is adapted to supply the rotor windings (3, 21, 46) of the main machine with a voltage with a frequency corresponding to the difference frequency between the synchronous frequency of the electric generator at the actual speed and the nominal frequency of the power network.

31. A method for using the converter, rotating with the shaft, according to claim 29 when the constant-frequency machine during operation is used as a motor, **characterized** in that the ac-to-ac converter (51a) is adapted to supply the rotor winding (3, 21, 46) of the main machine with a voltage with a frequency corresponding to the difference frequency between the frequency of the power supply network and the synchronous frequency of the machine at the desired speed.

32. A method for using the converter, rotating with the shaft, according to claim 29 during starting and stopping, **characterized** in that the ac polyphase coupler (51b) is adapted for direct connection of the rotor windings of the main machine and the rotor windings of the regulating machine.

33. A method for using the converter, rotating with the shaft, according to claim 29 during starting and controlled braking and stopping, **characterized** in that the ac phase-angle/voltage regulator (51c) is adapted for transmitting, in a controlled manner, the rotor losses of the

main machine via the regulating machine to external resistors.

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34. A method for using the converter, rotating with the shaft, according to claim 29 during starting/braking and/or stopping, **characterized** in that the ac short-circuit coupler (51d) is adapted to short-circuit the rotor windings of the regulating machine.